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ABSTRACT

Over a 14-month period, infants who were initially 10 months old were intermittently allowed to play with three sets of graduated objects presented in disarray. All of the infants acquired the ability to completely organize the materials. The infants inhibited patterned behavior in their organizing practices when they individualized objects by handling them one after another, filled and emptied containers one by one, nested the objects, established object identity patterns, and exhaustively imitated these patterns. This paper explores inferences from the infants' organizing procedures which can be applied to the task of communicating the place value concept, base ten, to preschool and elementary school children. Two questions are raised and answered: (1) In the learning environment staged for the infants, what principles functioned to guide their focal attention? and (2) What mechanisms caused change and continuity in the infants' behavior? It is asserted that continuous direct imitation of initially established identity patterns inevitably led to the infants' displays of organization; interruption was the causal mechanism of change; imitation the causal mechanism of continuity. Discussion specifies six rules of practice used by all the infants in organizing the materials and suggests requirements for an instructional plan for teaching the place value notation concept to children. The plan is similar to the research design of the study of infants. (RH)

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II Confirmation Principles and Procedures of 10 - 24 Month Old Children: Implications for Teaching the Place Value Notation Concept to Elementary and Preschool Children

ABSTRACT

This article is the second in a four-part series. Bentley analyzes the descriptive data of the Geneva report, a synopsis of which is contained in article #1. Her objective is to infer specific pedagogical insights which can be effectually applied to the task of communicating the place value notation concept, base ten, to elementary and preschool children. She comments that the Geneva research plan was an ingenious pedagogical design in that the environment was propitiously equipped and staged for specific discoveries. She raises two questions: In that propitiously staged learning environment what principles functioned to guide the children's focal attention? What mechanisms were the effectual cause of change and of continuity? She answers these questions and conjectures requirements for an instructional plan which would address the place value notation concept for children after the manner of the Geneva model.

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II Confirmation Principles and Procedures of 10 - 24 Month Old Children: Implications for Teaching the Place Value Notation Concept to Elementary and Preschool Children

A. Introduction

This article is the second in a four-part series. The first presents a synopsis of a report of Geneva research (1979, Sinclair, Unpublished) and my interpretation of it as an educator. The report described the onset and evolution of organizing procedures of ten to twenty-four month old children. In this paper I analyze the descriptive data in order to derive educational insights. My supposition is that the young children taught themselves something over the fourteen months as a consequence of their patterned interaction with materials regularly presented to them in disarray. The purpose of my analysis is to infer specific pedagogical insights which can be effectually applied to the task of communicating the place value notation concept to elementary and preschool children.

In article #1 I noted that the Geneva research plan was an ingenious pedagogical design which prompted and facilitated child-directed investigations. I noted also that the environment (especially data sets B and C) was propitiously equipped and staged for specific discoveries and confirmations. In that propitiously staged learning environment what principles functioned to guide the children's focal attention? What mechanisms were the effectual cause of change and of continuity?

Answers to these questions can help us to address the place value notation concept for elementary and preschool children with greater pedagogical effectiveness.

B. Enumeration of Chronological Sequences of Behavior (Data Sets B and C)

The following analysis enumerates the sequences of behavior exhibited by the Geneva youngsters over the fourteen month period. It is important to remember that on every occasion the environment presented to the children displayed scattered regularities of form, structure, and number. The overall appearance was that of chaotic disorganization. Organization which the children imposed from time to time over the fourteen month period was regularly dissolved after the children left the research environment. Thus organizations imposed by the children were impermanent, while presentation of disarray was a permanent feature of the circumstance of provision. Scattered regularities within a condition of overall disorder impacted the perceptions of the children each time they entered the research environment.

Sequence A:

1. Objects were handled individually one after another.
2. Objects were tapped, pointed to, and touched to different parts of the body.
3. Objects were passed from one hand to the other.
4. Two objects were clapped together

Sequence B:

1. An object was picked up and inserted in an open cube.
2. A second object was picked up and inserted in the same cube.
3. A third object was picked up and inserted in the same cube.
4. Insertion of objects in the cube continued one after another.
5. Interruption. (No more would fit in.)
6. Repetition of the same procedure in reverse.
7. Repetition of steps 1 - 5 followed by repetition in reverse.

Sequence C:

1. A single member of one class of objects, e.g. a ball, was picked up and inserted in an open cube.
2. A second member of the same class, i.e. another ball, was picked up and inserted in the same cube.
3. The same pattern of extrinsic, discriminative selection continued one item after another.
4. Interruption. (The supply, e.g. of balls, was exhausted.)
5. A single member of a different class, e.g. a stick, was picked up and inserted in an open cube.
6. A second stick was picked up and inserted in the same cube.

7. The same pattern of extrinsic, discriminative selection continued, one item after another.
8. Interruption. (The supply of sticks was exhausted.)
9. Exhaustive collection procedures based on a rule of extrinsic, discriminative one-by-one selection of members of a particular class were practiced until errorless performance (without need of a spatial envelope) was achieved.

Sequence D:

1. A cube:stick pattern was initiated.
2. A second cube:stick pattern was displayed.
3. A third cube:stick pattern was displayed.
4. The cube:stick pattern was continuously imitated.
5. Interruption. (The supply of sticks and cubes was exhausted.)

Sequence E:

1. A cube was picked up and inserted in a cube which was slightly larger in size.
2. A second cube was picked up and inserted in a slightly larger cube.
3. A third cube was picked up and the attempt was made to insert it in the last remaining slightly larger cube.
4. Interruption. (The cube would not fit in.)
   a. The small cube was inserted in the mouth.
   b. The cube was removed and placed on the table.

c. A finger was inserted in the cube.

5. The third cube was picked up and inserted in the last remaining, slightly larger cube.
6. Insertion practices continued until all the cubes were nested within the largest cube.
7. Interruption. (The supply of cubes was exhausted.)

Sequence F:

1. Perfect performance of sequence C.
2. Perfect performance of sequence D.
3. Perfect performance of sequence E.
4. Cessation. (Thereafter the children did different things with the same objects.)

C. The Sequences Compared and the Causal Mechanisms of Change and Continuity Revealed

The above enumeration facilitates comparison of the sequences and enables us to focus on points of similarity and difference in the circumstances and events which characterized each sequence. We notice first that there was no interruption between sequence A and sequence B. Sequence A was enumerative relative to the objects and organizational relative to the child's body. Sequence B was enumerative and organizational relative to the open cube. Sequence B was an analogical imitation of sequence A with the cube functioning in the role of the child's body. Sequence B was interrupted.

The circumstance of interruption signaled the beginning

of a succession of demonstrations of relation which culminated in the finale of behaviors outlined in sequence F. Effectively causing the demonstrations was the systematic and creative initiative of the children in imposing different arrangements on the objects. Effectively functioning to stimulate the imposition of different arrangements were regularities of form, structure, and number in the scattered disarray of objects.

The interruption (no more would fit in) posed a problem to the procedure of continuous imitation (one-by-one filling) and stimulated the first of four innovations. The first innovation was reverse imitation. It may be significant to notice that the procedure of reverse imitation in sequence B united the point of initiation (one object in cube), the point of transition (no more would fit in), and the point of conclusion (one object in cube) in a continuous event. The way to and from the point of transition was demonstrated as a continuous, reversible procedure of which the initial result and the final result were the same (one object in cube).

In sequences C, D, and E the one:one relation was systematically varied. The point of initiation successively established three different classes of identity relations. Every identity pattern was directly and exhaustively imitated. Random selection of objects (sequences A and B) was replaced by discriminative selection (sequences C, D, and E). The initial patterns of C, D, and E varied as to content but not as to the fundemental principles of a one:one relation and continuous direct imitation. Continuous direct imitation of each initial identity

pattern led inevitably to the displays of organization which occurred. Each pattern determined a rule of organization while the one:one principle guided the procedure of direct, continuous imitation. Sequence F was a finale, a concrete summation, in which the children reviewed the gamut of organizing procedures. Each identity pattern was posed and exhaustively imitated so that the inevitable consequences of the rule of each pattern in the procedure of enumeration was successively demonstrated.

Examination of the sequences in order enables identification of mechanisms which were the effectual cause of change and of continuity in the evolutionary sequence of events which occurred. Imitation was the causal mechanism of continuity; interruption was the causal mechanism of change.

D. Six Rules of Practice Implemented Universally by the Children

The following rules of practice were implemented by the children:

(1) The establishment of an initial identity pattern by imposing a one:one relation. Examples of identity relations from each sequence are listed below:

A. Object: body (random selection)

B. Object:cube (random selection)

C. Ball:ball (extrinsic, discriminative selection)

D, Cube:stick (extrinsic, discriminative selection)

E. Cube:cube (intrinsic, discriminative selection)

F. Final errorless review of C - E

(2) Continuous, successive imitation of each initial identity pattern until interrupted. Interruptions were of two kinds:

a. no more would fit in

b. the supply was exhausted

(3) Reverse imitation succeeded, type a.

(4) Establishment of a different identity pattern succeeded interruption, type b.

(5) Random selection preceded extrinsic, discriminative selection; extrinsic, discriminative selection preceded intrinsic, discriminative selection.

(6) A final review of all identity patterns previously initiated, practiced, and exhaustively applied to the set of objects was errorlessly conducted as a continuous, uninterrupted procedure

Sequence F (Rule 6) was a comprehensive and integrative experience for the children. Not just one or two, but all the identity patterns previously confirmed were successively and exhaustively represented in a final event of continuous, uninterrupted review.

E. The Significance of the Sequence F Event

All the children conducted the final sequence F event. Following this event the organizing practices abruptly ceased. Thereafter, the children did other things with the same objects. When the organizing procedures reappeared, they functioned as procedural tools in solving new problems.

If this combination of circumstances had occurred with only one child, it would be none the less interesting. That it occurred universally suggests that there is something of cognitive significance which can be inferred from it. I believe that the sequence F event was an external response to an internal need. I conjecture that the children were cognitively stressed by the regular dissolution (out of their sight) of every system of order they imposed on the objects. I further conjecture that this cognitive distress prompted the children to persevere in the organizing procedures and finally to impose them one after another in single, exhaustive, uninterrupted succession. Nothing was omitted which was pertinent to the comprehensive review. I believe that it pleased each of the children to conduct this review because it was an integrative experience. Because it was an integrative experience, it quenched the sense of cognitive distress. Impermanence of every order imposed by the children caused the sense of cognitive distress; integration quenched the sense of distress, and that is why the practice of organizing the objects ceased. The internal need was satisfied; therefore, the external manifestation ceased.

F. Implications for Pedagogical Design

My objective is to address the place value notation concept for elementary and preschool children after the manner of the Geneva model. Such a plan, it seems to me, must fulfill the following requirements:

(1) Environmental setups must be equipped so that component relations of the place value notation concept can be given unmistakably obvious concrete display.

(2) Environmental setups must be staged so as to: (a) stimulate children's interest; and (b) prompt and facilitate child-motivated, child-directed demonstrations of the component relations of the place value notation concept.

(3) Equipping and staging should be planned so that the two principles (one:one and imitation) will function to guide the children's focal attention and motivate pertinent acts of initiative which reveal specific component relations of the place value notation concept.

(4) Revelatory procedures must conform to the six rules of practice which characterized the effectual method of the Geneva children.

(5) Procedures conducted must lead toward and prepare the children to conduct independently a comprehensive review of the component relations of the place value notation concept.

(6) The culminating review must demonstrate the integrated harmony of all the component relations which have previously been displayed and confirmed.

In the third article of this series I present a plan which fulfills these requirements.

G. Conclusion

Environmental design played a key role in stimulating and enabling the evolutionary behavioral developments which occurred. Organization and the implementation of organizational method were facilitated by constancy and equivalencies in the provision of a limited number of obvious regularities. The environment was potentially revelatory because the regularities were visually perceptible and motorically confirmable.

Two principles functioned to motivate, guide, and govern behavior: a principle of one:one relation and a principle of imitation. Regularities of form, structure, and number motivated exploration, while the principles of one:one relation and imitation assured orderly exploration and the imposition of order. Imitation was the causal mechanism of continuity; interruption was the causal mechanism of change.

The circumstance of disarray was stimulating to the children. Visual perception of regularities within the disarray prompted implementation of identity patterns. The principle of imitation assured their exhaustive enumeration. The provision of equivalencies enhanced comparison of classes (e.g. stick: cube) and, I conjecture, provided a sense of unity over all. This unity might explain the culminating event of review as an extension of the one:one principle to classes of objects: viz. Self is to all the balls, sticks, cubes; self is to stick:cube patterns; self is to nested cubes.

The sequence F event was an external response to an internal need. Regular dissolution (out of their sight) of every system

of order they imposed caused the children cognitive distress. The sense of distress motivated the children to persevere in practicing the organizing procedures until they were able in a single twenty-minute play session to conduct a perfect finale of review. This caused a sense of integration to replace the sense of cognitive distress. Therefore, the organizing practices ceased abruptly.